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| 10/099,794 | 03/15/2002 | Bich-Yen Nguyen | SC11360TP P01 | 5563 |

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EXAMINER

LE, DUNG ANH

ART UNIT

PAPER NUMBER

2818

DATE MAILED: 04/01/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Appli cation No.

10/099,794

Applicant(s)

NGUYEN ET AL.

Examin er

DUNG A LE

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 December 2002.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-45 is/are pending in the application.
- 4a) Of the above claim(s) 19-41 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6-18 and 42-45 is/are rejected.
- 7) ☒ Claim(s) 5 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

The previous Office Actions are withdrawn, this is a ground of rejection.

Set of claim 1-9:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1- 6, 8 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Duncombe et al. (6255122) in view of Kita et al. (5403792).

Duncombe et al. disclose a semiconductor structure comprising:
a semiconductor substrate 10;
a dielectric layer 30 comprising lanthanum, aluminum and oxygen, over the semiconductor substrate 10 (col 4, lines 34-54); and
an electrode layer 40 over the dielectric layer 30. (fig. 1).

Duncombe et al do not disclose a dielectric layer comprising lanthanum, aluminum and oxygen, and nitrogen.

Kita et al. teach a dielectric layer as a oxide comprising lanthanum, aluminum, oxygen, and nitrogen as set forth in column 1, line 65 to column 2, line 1.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a dielectric layer comprising lanthanum, aluminum, oxygen, and nitrogen, as taught by Kita et al. in order to obtain the best resultant semiconductor device having the high-K dielectric constant as gate insulating.

Regarding claim 2, Duncombe et al teach an interfacial 20 layer between the semiconductor substrate 10 and the dielectric layer 30.

Regarding claims 3 and 4, Duncombe et al and Kita et al. teach the claimed invention except for the interfacial layer comprises silicon, nitrogen, and oxygen and the interfacial layer comprises aluminum, nitrogen, and oxygen.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the interfacial layer comprises silicon, nitrogen, and oxygen and the interfacial layer comprises aluminum, nitrogen, and oxygen that are commonly used to prevent undesirable reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claim 6, the dielectric layer is amorphous (Duncombe et al. col 4, line 34).

Regarding claim 8, Duncombe et al teach the electrode layer is a gate electrode
(col-3, line 66).

Claim 7 is rejected under 35 U.S.C. 103 (a) as being unpatentable over
Duncombe et al. in view of Kita et al. as applied to claim 1 above, and further in
view of Sunnerfelt et al. (5471364).

Duncombe et al. disclose the claimed invention including the substrate is made of silicon, but Duncombe et al. and Kita et al. do not disclose the semiconductor substrate is selected from a group consisting of monocrystalline silicon, gallium arsenide, silicon on insulator, silicon germanium and germanium.

Sunnerfelt et al. teach (in fig. 5 and col 5, line 20-25) that the semiconductor substrate is selected from a group consisting of monocrystalline silicon, gallium arsenide, silicon on insulator, silicon germanium and germanium.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the semiconductor substrate is selected from a group consisting of monocrystalline silicon, gallium arsenide, silicon on insulator, silicon germanium and germanium , as taught by Sunnerfelt et al. in order to obtain the optimum performance of the present invention.

Claim 9 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Duncombe et al. in view of Kita et al. as applied to claim 1 above, and further in view of Hsieh (4879079).

Duncombe et al. and Kita et al. disclose the claimed invention except for one element of the dielectric layer is graded from zero to a predetermined amount greater than zero.

However, Hsieh teaches that one element of the dielectric layer is graded from 1 to a predetermined amount greater than zero that is 10. (col 1, line 62 to col 2, line 8, especially in col 1, line 62-64).

One of ordinary skill in the art would have readily recognized the advantage and desirability to modify Duncombe et al. and Kita et al. by using Hsieh in order to archive the benefits of the thin high-K dielectric film which can be employed in forming electronic devices.

Set of claim 10-13:

Claims 10 -13 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Duncombe et al. (6255122) in view of Kita et al. (5403792).

Duncombe et al. disclose a semiconductor structure comprising:

a first conductive layer 20;

a dielectric layer 30 comprising lanthanum, aluminum and oxygen over the first conductive layer; and

a second conductive layer 40 over the dielectric layer.

Duncombe et al do not disclose a dielectric layer comprising lanthanum, aluminum-oxygen, and nitrogen.

Kita et al. teach a dielectric layer as a oxide comprising lanthanum, aluminum, oxygen, and nitrogen as set forth in column 2, line 65 to column 1, line 1.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a dielectric layer comprising lanthanum, aluminum, oxygen, and nitrogen, as taught by Kita et al. in order to obtain the best resultant semiconductor device having the high-K dielectric constant as gate insulating.

Regarding claims 11-13, the first conductive layer is a floating gate; at least one of the first conductive layer and the second conductive layer is a capacitor plate and the first conductive layer is floating gate (fig. 1).

Set of claims 14- 18:

Claims 10 -13 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Duncombe et al. (6255122) in view of Kita et al. (5403792).

Duncombe et al. disclose a semiconductor structure comprising:

a semiconductor substrate 10;

a first dielectric layer 20 formed over the semiconductor substrate 10;

a second dielectric layer comprising lanthanum, aluminum and oxygen, formed over the first dielectric layer 20; and

an electrode layer 40 over the dielectric layer 30 .

Duncombe et al do not disclose a second dielectric layer comprising lanthanum, aluminum oxygen, and nitrogen.

Kita et al. teach a dielectric layer as a oxide comprising lanthanum, aluminum, oxygen, and nitrogen as set forth in column 2, line 65 to column 1, line 1.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a second dielectric layer comprising lanthanum, aluminum, oxygen, and nitrogen, as taught by Kita et al. in order to obtain the best resultant semiconductor device having the high-K dielectric constant as gate insulating.

Regarding claims 15, 17 and 18, Duncombe et al and Kita et al. disclose the claimed invention except for the first dielectric layer is less than approximately 10 angstroms (1 nanometer) thick, and the second dielectric layer is between approximately 20-90 angstroms (2-9 nanometers) thick; the first dielectric layer is between approximately 10-90 angstroms (1-9 nanometers) thick, and the second dielectric layer is between approximately 5-20 angstroms (0.5 to 2 nanometers) thick and the first dielectric layer has a dielectric constant ($K\epsilon$) in excess of 5 as cited in the present claim 15, 17 and 18.

However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the first dielectric layer and second dielectric-layer having the abovementioned limitations, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

Regarding claim 16, Duncombe et al and Kita et al. discloses the claimed invention except for the first dielectric comprises one of silicon oxide, oxynitride, and aluminum oxide.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the first dielectric comprises one of silicon oxide, oxynitride, and aluminum oxide which are commonly used to prevent undesirable reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

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Set of claims ~~41~~-45.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 42 is rejected under 35 USC 102 (e) as being anticipated by Kita et al. e (5403792).

Kita et al. disclose a semiconductor structure (column 1, line 65 to column 2, line 1) comprising:

- a semiconductor substrate ;**
- a dielectric feature comprising lanthanum, aluminum, nitrogen and oxygen over the semiconductor substrate .**

Claims 43-45 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Duncombe et al. (6255122) as applied in claim 42 above, in view of Takahashi et al. (5906874).

Regarding claims 43, Duncombe et al. teach the claimed invention except for the dielectric feature consists of nitrided lanthanum aluminate.

Takahashi et al. show the dielectric feature further comprises Lanthanum, Silicon, Oxygen and nitrogen as set forth in column 5, line 65-67.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the dielectric feature consists of nitrided lanthanum

aluminate in order to obtain the best resultant semiconductor device having the high-K dielectric constant as gate insulating.

Regarding claims 44 and 45, Duncombe et al. and Kita et al. disclose the claimed invention except for the dielectric feature comprises one of a gate dielectric, an etch stop layer, a trench liner, and a sidewall spacer liner and the dielectric feature functions as a diffusion barrier.

It would have been an obvious matter of design choice to form the dielectric feature comprises one of a gate dielectric, an etch stop layer, a trench liner, and a sidewall spacer liner and the dielectric feature functions as a diffusion barrier, since applicant has not disclosed that providing the above limitations solve any stated problem or is for any particular purpose and it appears that the invention would perform equally well with any particular application.

Allowable Subject Matter

Claim 5 is are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, since the prior made of record and considered pertinent to the applicant's disclosure does not teach or suggest the claimed limitations. Duncombe et al. (6255122), Kita et al. (5403792) and Hsieh (4879079), taken individually or in combination, do not teach the claimed invention having a concentration

of nitrogen in the dielectric layer is higher adjacent the electrode layer as compared to adjacent the semiconductor substrate (**Regarding claim 5**).

When responding to the office action, Applicants' are advice to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is 703-306-5797. The examiner can normally be reached on Monday-Friday 8:00am-5: 30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on 703-308-4910. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Dung A. Le
Examiner
Art Unit: 2818

